REMARKS

Double Patenting Rejection

In the non-final office action mailed October 4, 2004 ("Office Action"), the Examiner found claims 1-32 to be "rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-6, 7, 13-16 of U.S. Patent No. 6,733,455." Office Action, pg. 2.

A timely filed terminal disclaimer in compliance with 37 C.F.R. § 1.321(c) may be used to overcome a rejection based on a non-statutory double patenting rejection provided the conflicting patent is commonly owned with the pending application.

Applicants submit herewith a terminal disclaimer in accordance with 37 C.F.R. § 1.321(c) and signed by a registered attorney of record. The entire right, title and interest in U.S. patent number 6,733,455 and the present application are held in the name of Zonare Medical Systems, Inc. of Mountain View, California.

With regard to U.S. patent number 6,733,455, an assignment from the inventors/applicants to Novasonics, Inc. is recorded before the U.S. Patent Office at Reel 013002 and Frame 0383. A change of name from Novasonics, Inc. to Zonare Medical Systems, Inc. is recorded at Reel 015530 and Frame 0772. With regard to the presently pending application (10/825,719), an assignment from the inventors/applicants is recorded at Reel 015229 and Frame 0633. A change of name from Novasonics, Inc. to Zonare Medical Systems, Inc. is recorded as Reel 015530 and Frame 0772.

Having submitted a terminal disclaimer in accordance with 37 C.F.R. § 1.321(c) and having established common ownership of the conflicting patent and present application, applicants believe the double patenting rejection is overcome.

Claim Rejections Under 35 U.S.C. § 102(e)

The Examiner, in the October 4 office action, rejected claims 1-7 and 17-22 pursuant to 35 U.S.C. § 102(e) in light of U.S. patent number 6,689,064 to Hager et al. ("Hager"). Applicants respectfully traverse the Examiner's rejection for while Hager

and the present application are both concerned with clutter filtering of ultrasound images, a closer reading of the disclosure of Hager and the applicants' claimed invention reveals two fundamentally different approaches to achieving clutter filtering.

- **Linear Predictive (AR) Filtering v. High Pass Filtering**

First, Hager is concerned with an "autoregressive parametric technique" for clutter filtering. Hager at col. 1, l. 51-52. Hager "modifies clutter coefficients based on . . . linear prediction and adaptive lattice filtering." Hager at col. 1, l. 60-62; see also Hager at col. 3, l. 8-10 ("the filter architecture is based on linear prediction lattice filtering").

Linear predictive filtering—also referred to as AR filtering—"is a technique that estimates the spectral content of a signal by appropriate selection of filter coefficients." Hager at col. 3, l. 10-12. Linear prediction/AR filtering is also dependent upon "selecting filter coefficients that minimize prediction error." Hager at col. 3, l. 31-33. The lattice filter employed by Hager further offers "a modular structure" that "receives the sample stream [of ultrasound data] and the filter coefficients [generated by a coefficient calculator], and has a variable configuration that is defined by the filter coefficients." Hager at col. 3, l. 56; col. 4, l. 48-50. The lattice filter subsequently "produces a forward prediction error $e_1^f(n)$ and a backward prediction error $e_1^b(n)$." Hager at col. 5, l. 13-15. Hager's "AR coefficients can be used to estimate mean-Doppler frequency of blood and/or clutter components of ultrasonic signals." Hager at col. 7, l. 39-41.

The Applicants' presently claimed invention, however, uses **high-pass filters** (HPF) as noted in amended claims 1 and 17. See, e.g., claim 1 ("a processor configured to iteratively select an optimal ***high pass*** filter") (emphasis added). This amendment finds support in the specification at, for example, paragraph **[0080]** with regard to applying a HPF to I/Q Data. See Application, p. 26, l. 23-p.27, l. 23; see also Application, p. 28, l. 1-4; p. 31, l. 6-p. 33, l. 1. Contrary to the linear prediction models and lattice filters of Hager, high pass l. 1-filters remove frequencies below a certain threshold; for example, strong signals from slow moving tissue such as vessel walls and cardiac leaflets. These thresholds are, generally, selectable. As specifically noted in the

disclosure of applicants' invention, "[w]hen using a HPF . . . the ultrasound signal from the transducer is passed through a linear high pass Finite Impulse Response (FIR) or Infinite Impulse Response (IIR) filter in the time domain. A high pass filter response such as HPF1 106 shows which frequency band is attenuated, and which frequency band is allowed to pass." Application at p. 8, l. 19-23.

Applicants submit that Hager is limited ***exclusively*** to linear predictive (AR) filtering and implementation of lattice structures in conjunction with that AR filtering. As such, the teachings of Hager can ***only*** be interpreted and applied in the light of such exclusivity with regard to Hager being a possible anticipatory reference. Applicants further submit there is no suggestion in Hager nor is there any possible extrinsic evidence or general knowledge of one of ordinary skill in the art that would suggest that the adaptive clutter filter of Hager be used in the context of classical high pass filters (FIR or IIR) that directly remove frequencies below certain cutoffs, without involving any estimation or prediction step as in applicants' presently claimed invention. Reference to the specification and figures of Hager indicates that Hager is *clearly* concerned with AR model and lattice structures. C.f. In re Robertson, 169 F.3d 743, 745 (Fed. Cir. 1999) (requiring any extrinsic evidence "make clear" the possibility of alternative, inherent teachings).

As "[a] claim is anticipated ***only*** if ***each and every element*** as set forth in the claim is found, either expressly or inherently described, in a single prior art reference," Hager cannot be said to anticipate 'a processor configured to iteratively select an optimal **high pass** filter.' Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631 (Fed. Cir. 1987) (emphasis added). As noted by the Examiner in the October 4 office action, "Hager et al teaches . . . a processor 120 . . . configured to select ***optimal filter coefficients*** for filtering out clutter from ultrasound color flow imaging data by an iterative process." Office Action, pg. 4 (emphasis added). Optimal filter coefficients—linear prediction/AR filtering—differ from Applicants' claimed high pass filtering thereby evidencing Hager's failure to show "[t]he identical invention" "in as complete

detail as is contained in the . . . claim." Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236 (Fed. Cir. 1989).

• **Iterative Determination of Signal Strength v. Iterative Selection of a Filter for Ordered, Progressive Filtering of the Original Ultrasound Signal**

The presently claimed invention further differs from Hager in that Hager, as noted in the Examiner's October 4 office action, "[t]hrough an iterative process, [determines] the ***signal strength and frequency*** [of clutter and blood data]." Hager at col. 2, l. 10-11 (emphasis added); see also Office Action, pg. 4 (citing Hager at col. 2, l. 10-13). Applicants' claimed invention, however, 'iteratively selects an optimal ***high pass filter.***' See, e.g., claims 1 and 17. The iterative determination of ***signal strength***, as in Hager, is ***not*** the same as the iterative selection of a ***filter***. See In re Bond, 910 F.2d 831 (Fed. Cir. 1990) (requiring the elements an allegedly anticipatory reference to be arranged as required by the claim).

Hager's 'iterative process' simply chooses the best AR filtering model based on the power range of the signal. Referring to Figure 3, Hager shows "a flowchart of a method for adaptive filtering of clutter from a sample stream having a blood signal component and a clutter signal component [305]." Hager at col. 9, l. 48-50. This method comprises first (iteratively) "estimating a signal strength of the sample stream [310]." Hager at col. 9, l. 52; see also Hager at col. 2, l. 10 ("[t]hrough an iterative process, the signal strength and frequency are each determined). Subsequent to the iterative estimation of signal strength, Hager "determin[es] an order of a filter based on a relationship between the signal strength estimate and a signal strength threshold [*e.g.*, 315, 325, 335]"; the filter then "receives the sample stream and provides an output stream having a reduced level of the clutter signal component [365]." Hager at col. 9, l. 53-57.

The so-called iterative process of Hager is nothing more than a systematic search of the closest three or four pre-determined ***power ranges*** prior to any filtering. Once the power range is determined, the corresponding AR model is applied ***once*** (*e.g.*, Fig. 3 at

345) whereby "the method determines the output signal Y by convolving the input signal X with the filter coefficients." Hager at col. 11, l. 1-3.

In contrast, the Applicants' claimed invention iteratively selects an optimal high pass filter and then submits original ultrasound color flow imaging data for ***progressive, ordered*** filtering. See, e.g., claims 1 and 17. That is, the original signal is progressively subjected to an ordered set of high pass filters until clutter is deemed to be entirely or substantially removed.

Furthermore, the ultrasound image data input to the high pass filter ***in each iteration*** is the ***original ultrasound signal*** and the clutter presence test is based on computation of specific indices of the mean frequency and of the signal magnitude. This computation is reflected, for example, in amended claim 1, which recites computing an index 'using a mathematical formula including a mean frequency and a magnitude of a filtered signal wherein the high pass filter input for each iterative selection is the original ultrasound color flow imaging data.' This amendment finds support in the specification, for example, at paragraph **[0091]**. Application, p. 33, l. 2-5.

More succinctly, the iterative filtering process of Applicants' claimed invention progressively passes the same ***original ultrasound signal*** through an ***ordered set*** of ***high pass filters*** with different cutoff frequencies whereby each high pass filter can be implemented using different structures. Hager, however, represents a filtering methodology whereby the outputs of the different filtering stages are but intermediate results. Hager only systematically searches for a pre-determined power range prior to filtering and further suffers from impracticalities such as implementing arc tangent and division operations involved in evaluation of the mean frequency. See Hager at col. 11, l. 65.

Hager's failure to show "[t]he identical invention" "in as complete detail as is contained in the . . . claim"—systematically searching for a predetermined power range followed by the singular application of a corresponding AR model versus iterative selection of a filter wherein the same ultrasound data is progressively filtered in each

selection—prevents anticipation of claims 1 and 17. Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236 (Fed. Cir. 1989).

Claims 2-7 and 18-22 were also rejected by the Examiner under 35 U.S.C. § 102(e). See Office Action, 3. Claim 2-7 and 18-22 depend, respectively, upon rejected claims 1 and 17. "A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." 35 U.S.C. § 112, ¶ 4. The Applicants, believing the Examiner's rejections with regard to claim 1 and 17 having been overcome as set forth above, contend claims 2-7 and 18-22 to also be allowable for at least the same reasons.

Claim Rejections Under 35 U.S.C. § 103(a)

The Examiner, in the October 4 office action, rejected claims 8-16, 23, 25-29 and 31-32 under 35 U.S.C. § 103(a) in light of Hager and that which would be, according to the Examiner, "inherently obvious." Office Action, pg. 5. Claims 24 and 30 were rejected "as being unpatentable over Hager et al. in view of applicants (sic) prior art admissions." Office Action, pg. 6.

- **Claims 8 and 23: Dependency Upon an Allowable Base Claim**

With regard to claim 8, Applicants note that claim 8 is dependent upon claim 7, which is, in turn, dependent upon claim 1. Applicants contend, as set forth above, that Hager fails to teach each and every limitation of claim 1.

In order to establish a *prima facie* case of obviousness, ***all*** the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981 (CCPA 1974); see also In re Wilson, 424 F.2d 1382, 1385 (CCPA 1970) ("[a]ll the words in a claim must be considered in judging the patentability of that claim against the prior art"). As claim 1's limitations are incorporated by reference into claim 7 and subsequently into claim 8, as a matter of law, claim 8 cannot be obvious—especially in light of the same reference (Hager) that fails to teach all the limitations of underlying base claim 1. As such, Applicants contend claim 8 to be allowable for at least the same reasons as claim 7 and 1.

See In re Fine, 837 F.2d 1071 (Fed. Cir. 1988) (if an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending there from is also nonobvious).

Claim 23 is dependent upon claim 17, which Applicants previously contended to be allowable for reasons similar to claim 1 (*i.e.*, the failure of Hager to teach each and every limitation of claim 1). As Hager fails to anticipate base claim 17, claim 23 that incorporates all of the limitations of claim 17, cannot be obvious—especially in light of the same reference (Hager) that fails to teach all the limitations of underlying claim 17. As such, applicants contend claim 23 to be allowable for at least the same reasons as claim 17. See In re Fine, 837 F.2d 1071.

- **Independent Claims 9 and 25 and Related Dependencies**

In rejecting independent claims 9 and 25, the Examiner asserted "the frequency shift for the data" in Hager to be "determined by the autocorrelation lag ratio of imaginary to real components"; "this in turn is compared with frequency thresholds to determine clutter range." Office Action, pg. 5. The Examiner found this teaching to be "tantamount to using the range threshold per se as the constant." Office Action, pg. 6. Notwithstanding—and without affirming—the Examiner's assertion, Hager still fails to teach iterative selection of optimal *high pass* filters for use in *progressive, ordered* filtering and, further, providing high pass filter input for each iterative selection that is the *original* ultrasound color flow data.

As a *prima facie* case of obviousness requires the presence of *all* claim limitation, the Examiner's rejection is overcome in that Hager fails to teach the progressively, ordered high pass filtering of the original ultrasound signal in each iterative cycle. See In re Royka, 490 F.2d 981 (CCPA 1974). In that regard, Applicants contend independent claims 9 and 25 to be allowable in addition to all related dependent claims: 10-16, 26-29 and 31-32. See In re Fine, 837 F.2d 1071.

New Claims 33-36

Applicants have added new claims 33-36. Applicants believe these new claims to be fully supported by the specification. See, e.g., Application at p. 8, l. 20-21. As these new claims depend on claims that applicants contend are now allowable (claim 17 via claim 23 and claim 1 via claim 7), applicants contend these new claims are also allowable. See In re Fine, 837 F.2d 1071.

CONCLUSION

Applicants believe the Examiner's double patenting rejection to be overcome through the submission of a terminal disclaimer. Applicants further believe the Examiner's 35 U.S.C. § 102(e) and 35 U.S.C. § 103(a) rejections to be overcome through distinguishing the presently claimed invention—iterative selection of optimal high pass filters for use in progressive, ordered filtering and the providing of high pass filter input for each iterative selection that is the original ultrasound color flow data—from Hager. Applicants have also amended the title and abstract to better reflect the presently claimed scope of the invention.

In light of these amendments and remarks, Applicants believe the application is in condition for allowance and respectfully request the issuance of a Notice of Allowance.

The Examiner is invited to contact Applicants' undersigned representative with any questions if he believes it would facilitate examination and expedient allowance of the application.

Respectfully submitted,
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